Chapter 1055 HOV Direct Access

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1055.01 General

This Chapter provides design guidance for left-side direct access facilities for high occupancy vehicles (HOVs) between freeway HOV lanes and public-transportation passenger facilities within the freeway right of way and facilities outside of the right of way. Design right-side HOV only access facilities per Chapter 940.

Direct access eliminates the HOV user crossing the general-purpose lanes from left-side HOV lanes to the right-side general-purpose ramps. Also, transit vehicles will be able to use the HOV lane and provide service to the HOV direct access facility.

Providing the HOV user access to the inside HOV lane without mixing with the general-purpose traffic saves the user additional travel time and aids in safety, enforcement, incident handling, and overall operation of the HOV facility.

Locations for direct access ramps include HOV facilities on intersecting routes, park and ride lots, flyer stops, and locations with a demonstrated demand. Coordination with the local transit agencies will result in the identification of these key locations. Give priority to locations that serve the greatest number of transit vehicles and other HOVs.

(1) Existing Facilities

When designing an HOV direct access facility, the existing general-purpose facilities must not be degraded. However, there may be opportunities to improve existing geometrics. These opportunities can be identified during the project definition phase.

When an HOV direct access facility project includes work on the existing facilities, apply the new/reconstruction row of the Interstate Design Matrices and the HOV row of the other matrices in Chapter 325.

(2) Reviews, Studies, and Reports

The normal project development process is to be followed when developing an HOV direct access project. Most facets of the project development process remain unchanged despite the unusual nature of the projects that are the focus of this chapter. For example, early coordination with others is always a vital part of developing a project. There are also environmental considerations, public involvement, and Value Engineering studies (Chapter 315). These are all necessary to ensure appropriate scope and costs.

There may also be reviews, studies, and reports required by agreements with regional transit authorities or other agencies.

An Access Point Decision Report (Chapter 1425) is required when there is a proposal to add, delete, or change an access point. Provide the operational analysis from the report for all flyer stops. For left-side connections, include the commitment that the connection will be used solely by HOVs or will be closed.

Throughout the project development phase, ensure that the:

- Project definition and cost estimate are correct.
- Project development process is on schedule.
- Project documents are biddable.
- Project will be constructible.
- Project will be maintainable.

Constructibility of HOV direct access facilities is an important consideration during the design phase. These facilities will typically be constructed on existing highways with traffic maintained on-site. Key goals are to:

- Ensure that the project can be built.
- Plan a construction strategy.
- Provide a safe work zone.
- Minimize construction delays.

Access to these facilities by maintenance crews must be considered. Avoid items that require a significant maintenance effort and might result in lane closure for routine maintenance or repair.

(3) Left-Side Connections

Left-side connections are allowed only when they serve HOVs only and connect to an HOV lane. The higher traffic volume associated with general-purpose traffic is not acceptable for left-side connections. If the demand for an HOV direct access decreases to the point that the HOV direct access connection is no longer desirable, the connection must be closed.

1055.02 References

Americans with Disabilities Act of 1990 (ADA).

ADA Accessibility Guidelines (ADAAG), The Access Board, http://www.access-board.gov/adaag/html/adaag.htm.

Manual on Uniform Traffic Control Devices for Streets and Highways, USDOT, FHWA; including the *Washington State Modifications to the MUTCD*, Chapter 468-95 WAC, (MUTCD).

Sign Fabrication Manual, M 55-05, WSDOT.

Standard Plans for Road, Bridge, and Municipal Construction (Standard Plans), M 21-01, WSDOT.

High-Occupancy Vehicle Facilities A Planning, Design, and Operation Manual, Parsons Brinkerhoff Inc.

FHWA/PB HOV Interactive 1.0 High Occupancy Vehicle Data Base from the U.S., Canada and Europe (CD ROM), USDOT, FHWA and Parsons Brinkerhoff Inc.

A Policy on Geometric Design of Highways and Streets (Green Book), 2001, AASHTO.

Guide for the Design of High Occupancy Vehicle Facilities, AASHTO.

Transit Implications of HOV Facility Design, WA-RD 396.1, September 1996, WSDOT and USDOT, Federal Transit Administration.

NCHRP 155, *Bus Use of Highways, Planning and Design Guidelines*.

NCHRP 414, *HOV Systems Manual*.

1055.03 Definitions

flyer stop a transit stop inside the limited access boundaries.

high occupancy vehicle (HOV) Vehicles that fit one of the following:

- Rubber tired municipal transit vehicles.
- Buses with a carrying capacity of sixteen or more persons, including the operator.
- Motorcycles.
- Recreational vehicles that meet the occupancy requirements of the facility.
- All other vehicles that meet the occupancy requirements of the facility, except trucks in excess of 10,000 lb gross vehicle weight.

HOV direct access facility a ramp and its connection directly to an HOV lane, exclusively for the use of high occupancy vehicles to move between the ramp and the HOV lane without weaving across general-purpose lanes.

intelligent transportation systems (ITS) a system of advanced sensor, computer, electronics, and communication technologies and management strategies - in an integrated manner – to increase the safety and efficiency of the surface transportation system.

ramp a short roadway connecting a main lane of a highway with another facility, such as a road, parking lot, or transit stop, for vehicular use.

ramp connection the pavement at the end of a ramp, connecting to a main lane of a highway.

ramp terminal the end of a ramp at a local street or road, transit stop, or park and ride lot.

transit stop a facility for loading and unloading passengers that is set aside for the use of transit vehicles only.

transit vehicle a bus or other motor vehicle that provides public transportation (usually operated by a public agency).

1055.04 HOV Access Types and Locations

To provide direct access for high occupancy vehicles from the HOV lane to a passenger loading facility, there are many options and many constraints. Following are some of the options (selected as being usable on Washington's freeways) and constraints to their use.

To select an option, it is necessary to first establish the need, choose possible locations, evaluate site features (such as terrain, existing structures, median widths), and evaluate existing HOV information (such as lanes, park and ride facilities, transit routes and schedules, and origin and destination studies). The chosen location must meet access point spacing requirements and must be proven not to degrade traffic operations on the main line.

Important constraints to transit stop designs are that passenger access routes and waiting areas must be separated from freeway traffic, passenger access to a bus is on its right side only, and passenger access to a loading platform must accommodate the disabled.

(1) Freeway Ramp Connection Locations

(a) **Spacing**

For minimum ramp connection spacing see Chapter 940. Include only left-side connections, in this evaluation.

However, traffic operations can be degraded by the weaving caused by a left-side on-connection followed closely by a right-side off-connection (or a right-side on-connection followed by a left-side off-connection). As a general rule, if the spacing between the HOV direct access ramp and the general-purpose ramp is less than one gap acceptance length [1055.05(6)(c)] per lane, make the HOV lane buffer separated. (See Chapter 1050.)

Conduct an analysis to ensure that the new ramp will not degrade traffic operations. See Chapter 1425 for the studies and report required for a new access point.

When an off-connection follows an on-connection, provide full speed-change lane lengths and tapers or at least sufficient distance for full speed-change lanes that connect at full width with no tapers. See 1055.05(6) and 1055.05(7). An auxiliary lane can be used to connect full-width speed-change lanes if there is not sufficient distance for both tapers.

(b) **Sight Distance**

Locate both on- and off-connections to the main line where decision sight distance exists on the main line. (See Chapter 650.)

(2) Ramp Terminal Locations

(a) **Local Streets and Roads**

Access to the HOV lane can be provided by a ramp that terminates at a local street or road. The local street or road may incorporate HOV lanes, but they are not required. See 1055.07 for signing and pavement markings.

Consider traffic operations on the local road. Locate the terminal where:

- It will have the least impact on the local road.
- Intersection spacing requirements are satisfied.
- Queues from adjacent intersections will not block the ramp.
- Queues at the ramp will not block adjacent intersections.
- Wrong way movements are discouraged.

When off-ramps and on-ramps are opposite each other on the local road, consider incorporating a transit stop with the intersection.

(b) **Park and Ride Lots**

HOV direct access ramps that connect the HOV lane with a park and ride lot provide easy access for express transit vehicles between the HOV lane and a local service transit stop at the park and ride facility. Other HOV traffic using the access ramp must enter through the park and ride lot, which can create operational problems.

(c) **Flyer Stops**

Median flyer stops do not provide general access to the HOV lane. Access is from the HOV lane to the transit stop and back to the HOV lane. No other vehicle access is provided. Ramps to and from the flyer stops are restricted to transit vehicles only.

(3) Ramp Types

(a) **Drop Ramps**

Drop ramps are generally straight, staying in the median, and connecting the HOV lane with a local road or flyer stop (Figure 1055-3).

(b) **T Ramps**

A T ramp is a median ramp, serving all four HOV access movements, that comes to a T intersection within the median, usually on a structure. The structure then carries the HOV ramp over the freeway to a local road or directly to a park and ride lot (Figure 1055-4). Through traffic is not permitted at the T; therefore, flyer stops are not allowed.

(c) **Flyover Ramps**

A flyover ramp is designed to accommodate high speed traffic by using flat curves as the ramp crosses from the median over one direction of the freeway to a local road, a park and ride lot, or an HOV lane on another freeway (Figure 1055-5).

(4) Transit Stops

(a) **Flyer Stops**

Flyer stops are transit stops inside the limited access boundaries for use by express transit vehicles using the freeway. They may be located in the median at the same grade as the main roadway or on a structure, on a ramp, or on the right-side of the main line.

The advantage of a median flyer stop is that it reduces the time required for express transit vehicles to serve intermediate destinations. A disadvantage is that passengers must travel greater distances to reach the loading platform.

With left-side HOV lanes, flyer stops located on the right side will increase the delay to the express transit vehicles by requiring them to cross the general-purpose lanes. However, these stops improve passenger access from that side of the freeway.

See Chapter 1060 for additional design information.

1. **Side-Platform Flyer Stops** Side-platform flyer stops are normally located in the median (Figure 1055-6) and have two passenger loading platforms, one on each side between the bus loading lane and the through HOV lane. This design provides the most direct movement for the express transit vehicle and is the preferred design for median flyer stops.

This design is relatively wide. Where space is a concern, consider staggering the loading platforms longitudinally.

Consider tall barrier to divide the directions of travel or staggering the loading platforms to prevent unauthorized at-grade movement of passengers from one platform to the other. (See 1055.07(1).)

2. **At-Grade Passenger Crossings** This design is similar to the side-platform flyer stop, except that passengers are allowed to cross, from one platform to the other, at-grade (Figure 1055-7). This design might eliminate the need for passenger access to one of the loading platforms with a ramp or an elevator and simplifies transfers. The passenger crossing necessitates providing a gap in the barrier for the crosswalk.

Only transit vehicles are allowed. Passenger/pedestrian accommodations must comply with the ADA.

Consider an at-grade passenger crossing flyer stop only when passenger volumes are expected to be low. Design at-grade passenger crossing flyer stops as the first stage of the stop, with the ultimate design being side-platform flyer stops with grade separated access to both platforms.

3. **Ramp Flyer Stops** When ramp flyer stops are located on an HOV direct access drop ramp (Figure 1055-8), the delay for the express transit vehicle will not be much more than that for a median stop, and passenger access and connectivity to local service transit routes, on the local street or road, are improved. A flyer stop on a right-side ramp works well with right-side HOV lanes and diamond interchanges in which express transit vehicles can use the off-ramp to connect with a bus route on the local road and the on-ramp to return to the HOV lane. However, a stop on a general-purpose right-side ramp with a

left-side HOV lane will increase the delay by requiring the express transit vehicle to use the general-purpose lanes and possibly degrade main line traffic operations by increasing weaving movements.

(b) **Off-Line Transit Stops**

1. **Park and Ride Stops** Transit stops located at park and ride lots provide transfer points between the express transit system and the local transit system, and there is convenient passenger access to the park and ride lot. When a direct access ramp is provided, express transit delays from the HOV lane to the stop are reduced. These delays can be reduced more by providing a median flyer stop with passenger access facilities connecting the park and ride lot to the flyer stop; however, this might be more inconvenient for the passengers.

2. **Stops at Flyer Stop Passenger Access Points** To minimize the distance a passenger must travel between express and local service transit stops, locate local system transit stops near passenger access facilities for the flyer stops (Figure 1055-9).

(5) Enforcement Areas

For HOV facilities to function as intended, it is necessary to enforce the vehicle occupancy requirement. Law enforcement officers need areas for observation that are near pull-out areas where both the violator and the officer can pull safely out of the traffic flow.

Consider locating observation and pull-out areas near any point where violators can enter or exit an HOV direct access facility. Examples of potential locations are:

- Freeway on- and off-connections for HOV direct access ramps.
- HOV direct access ramp terminals at parking lots.

For freeway HOV lanes, locate enforcement areas on the adjacent shoulders so officers and violators are not required to cross several lanes of traffic.

Enforcement area guidance and designs are in Chapter 1050.

1055.05 Direct Access Geometrics

HOV direct access ramps are different from other ramps because they are frequently on the left-side of the through lanes and they have a high percentage of buses. Design right-side HOV direct access using the procedures given in Chapter 940. The following procedures are for the design of left-side HOV direct access.

Because left-side ramps are rare and are therefore less expected, signing is an important issue. (See 1055.07(2), for signing requirements.)

When the bus percentage is high, there are several needs to be met.

- When a bus enters the through lanes from the left, the driver has a relatively poor view of the through traffic.
- A bus requires a longer distance to accelerate than other vehicles.
- A bus requires a longer deceleration length for passenger comfort.

For these reasons, use the following design values when designing left-side HOV direct access facilities.

(1) Design Vehicles

Use AASHTO's A-BUS vehicle for horizontal design.

Use AASHTO's BUS vehicle for vertical clearance 13.5 ft.

Use AASHTO's P vehicle for stopping sight distance.

See Chapters 910 and 1060 for vehicle descriptions, dimensions, and turning templates.

(2) Design Speeds

See Chapter 940 for the design speeds for the ramps. Use the design speed of the general-purpose lanes for the main line design speed.

(3) Sight Distance

Provide stopping sight distance per Chapter 650. This provides sight distance for an automobile. The longer distance required for a bus to stop is compensated for by the greater eye height of the driver with the resulting vertical curve length requirement about equal to that for an automobile.

Sag vertical curves may be shortened where necessary. See Chapter 630 for guidance.

(4) Grades

Grades for ramps are covered in Chapter 940. Deviations will be considered for:

- Downgrade on-ramps with grades increased by an additional 1%.
- Upgrade off-ramps with grades increased by an additional 2%.

These increased grades help when geometrics are restricted and assist transit vehicles with the acceleration when entering and the deceleration when exiting the freeway.

(5) Ramp Widths

(a) **Lane Widths**

Use widths for separated roadway HOV facilities, see Minimum Traveled Way Widths for Articulated Buses, in Chapter 1050.

On tangents, the minimum lane width may be reduced to 12 ft.

(b) **Shoulder Widths**

Ramp shoulder width requirements are modified as follows:

- The minimum width for the sum of the two shoulders is 10 ft for one-lane ramps and 12 ft for two or more lanes.
- One of the shoulders must have a width of at least 8 ft for disabled vehicles. The minimum for the other shoulder is 2 ft. See Chapter 710 for shy distance requirements at barrier.
- The wider shoulder may be on the left or the right as needed to best match the conditions. Maintain the wide shoulder on the same side throughout the ramp.

(c) **Total Ramp Widths**

Make the total width of the ramp (lane width plus shoulders) wide enough to allow an A-BUS to pass a stalled A-BUS. This width has two components:

- The vehicle width (U = 8.5 ft on tangent) for each vehicle.
- Lateral clearance (C = 2 ft) for each vehicle.

The vehicle width and the lateral clearance are about the width of an A-BUS from edge of mirror to edge of mirror.

Figure 1055-1 gives the minimum ramp width (W_R) at various radii (R) for an articulated bus. For ramp locations on a tangent section or on a curve with a radius greater than 150 ft, consider the W_R width when requesting a reduced lane or shoulder width. For ramp curves with a radius less than 150 ft, check the total ramp width and, if necessary, widen the shoulders to provide the W_R width.

R (ft)*	W_R (ft)
Tangent	21
500	23
400	23
300	24
200	26
150	27
100	30
75	34
50	40

* R is to the curve inside edge of traveled way

Minimum Ramp Widths for Articulated Buses
Figure 1055-1

(6) On-Connections

(a) **Parallel On-Connections**

For left-side on-connections, use the parallel on-connection. See Figure 1055-10.

A parallel on-connection adds a parallel lane that is long enough for the merging vehicle to accelerate in the lane and then merge with the through traffic. This merge is similar to a lane change and the driver can use side and rear view mirrors to advantage.

(b) **Acceleration Lanes**

Figure 1055-11 gives the minimum acceleration lane length (L_A) for left-side HOV direct access on-connections.

The numerous buses using HOV direct access ramps must merge with high speed traffic. Acceleration lanes that are longer than normally required are needed.

For left-side on-connections, provide at least the normal 10 ft (14 ft preferred) wide left shoulder for the main line for a minimum length of 500 ft (1000 ft preferred) beyond the end of the on-connection taper. This gives additional room for enforcement, merging, and erratic maneuvers.

(c) **Gap Acceptance Length**

Gap acceptance length is a minimum distance traveled while a merging driver finds a gap in the through traffic and begins the merge. For left-side parallel on-connections the gap acceptance length is added to the acceleration length. The L_g values are given in Figure 1055-2. These values are larger than for right-side on-connections to account for drivers' visibility constraints.

Highway Posted Speed (mph)	Gap Acceptance Length L_g (ft)
45	550
50	625
55	700
60	775
65	850
70	925

Gap Acceptance Length for Parallel On-Connections
Figure 1055-2

(d) **Design of Urban On-Connections**

Design left-side HOV direct access on-connections in urban areas as follows:

1. Use the parallel design for all left-side on-connections.

2. Add the Gap Acceptance Length for Parallel On-Connections (Figure 1055-2) for a freeway speed of 60 mph to the acceleration length.

3. Use Acceleration Length for Buses (Figure 1055-11) with a 60 mph freeway speed and the ramp design speed [1055.05(2)] for acceleration length.

(e) **Design of Rural On-Connections**

Design left-side HOV direct access on-connections in rural areas using a freeway design speed as determined using Chapter 440.

(7) Off-Connections

(a) **Parallel Off-Connection**

The parallel off-connection (Figure 1055-12) is preferred for left-side direct access off-connections. For freeway to freeway off-connections, provide a parallel lane with a length sufficient for signing and deceleration. The desirable minimum length is not less than the gap acceptance length (Figure 1055-2).

(b) **Tapered Off-Connection**

The tapered off-connection may be used for off-connections with justification. See Chapter 940 for the design of tapered off-connections.

(c) **Deceleration Lanes**

Bus passenger comfort requires longer deceleration lanes. Use the deceleration lane lengths from Figure 1055-14 for HOV direct access facilities.

(d) **Design of Urban Off-Connections**

Design left-side HOV direct access off-connections in urban areas as follows:

1. Either the parallel (preferred) or the taper (with justification) design may be used.

2. Use the longer deceleration length of: the Deceleration Length for Buses (Figure 1055-14) from a 60 mph freeway speed to the ramp design speed [1055.05(2)], or the Minimum Deceleration Length given in Chapter 940 from the freeway design speed to the ramp design speed.

(e) **Design of Rural Off-Connections**

Design left-side HOV direct access off-connections in rural areas using a freeway design speed as determined using Chapter 440.

(8) Vertical Clearance

Vertical clearance for a structure over a road is measured from the lower roadway surface, including the usable shoulders, to the bottom of the overhead structure.

See Chapter 1120 for information on vertical clearance. For a new structure and for a new ramp under an existing structure, the minimum vertical clearance is 16.5 ft. A deviation will be considered for 14.5 ft minimum vertical clearance for a new HOV direct access ramp under an existing bridge.

The minimum vertical clearance for a pedestrian grade separation over any road is 17.5 ft.

(9) Flyer Stops

Design flyer-stop-ramp on-connections as given in 1055.05(6) and design off-connections as given in 1055.05(7). Flyer stop connections are included in the access point spacing discussed in 1055.04(1)(a).

Design the ramp to the flyer stop per 1055.05(3), 1055.05(4), and 1055.05(5).

The minimum width for the roadway at a flyer stop is 24 ft.

When a flyer stop is in the median, provide enough median width for the flyer stop roadway, the passenger facilities, and barrier separation without reducing the width of the through lanes or shoulders. (See 1055.06.)

The approval of a flyer stop requires the operational analysis portion of the Access Point Decision Report (Chapter 1425).

(10) T Ramps

A T ramp example and design is given on Figure 1055-15

1055.06 Passenger Access

When designing transit stops, accessibility (compliance with the ADA), safety, and the comfort of the passengers must be included. Minimize pedestrian/vehicle conflict points. Design the whole facility with security in mind by keeping lines of sight as open as possible. Traffic barriers, fencing, illumination, landscaping, seating, windscreens, shelters, enclosed walkways, telephones, and posted schedules are examples of factors that contribute to passenger safety and well-being. See Chapter 1060 for passenger amenities at transit stops.

(1) Passengers

To encourage use of the passenger access facility for an express transit stop, provide a route that is the shortest distance to travel from the park and ride lot, or local transit stop. Failure to do so might generate the use of undesirable shortcuts. To encourage local use of the passenger access facilities, provide direct access from surrounding neighborhoods.

To access a transit stop in the median or to move about within the facility, grade separations are required for all flyer stop designs except the at-grade crossing flyer stop. Consider stairways, ramps, elevators, and escalators, but provide at least one access for the disabled at every loading platform, as required by the American Disabilities Act of 1990. See Chapter 1025 for guidance when designing pedestrian grade separations.

The ADA Accessibility Guidelines for Buildings and Facilities includes: “Platform edges bordering a drop-off and not protected by platform screens or guard rails shall have a detectable warning … 24 inches wide running the full length of the platform drop-off.” See the Standard Plans for the detectable warning pattern.

In transit stops, at-grade crosswalks are only permitted in the at-grade crossing flyer stop layout described in 1055.04(4)(a)2. Use traffic calming techniques, such as horizontal alignment, textured pavement and crosswalk markings, barrier openings, and other treatments, to channelize pedestrian movements and slow the transit vehicle movements. Illuminate transit stop crosswalks. (See Chapter 840.)

Where at-grade crosswalks are not permitted, steps must be taken to minimize unauthorized at-grade crossings. Fencing, taller concrete traffic barrier, enclosed walkways, and ramps are examples of steps that may be taken.

(2) Bicycles

Bike lanes on nearby streets and separate trails encourage people to bicycle from surrounding neighborhoods. Provide these bicyclists direct access to passenger access facilities.

For bike-bus-bike commuter access to a transit facility, design bicycle access facilities in conjunction with the access for the disabled. (See Chapters 1020 and 1025.)

Locate bicycle parking outside of the passenger walkways. See Chapter 1060.

Locations near colleges and universities and locations with good bicycle access, especially near trails, will attract bicyclists. Contact the region Bicycle Coordinator for information on the predicted number of bicycle parking spaces needed and the types of bicycle racks available.

1055.07 Traffic Design Elements

Traffic design elements are critical to the safe and efficient use of HOV direct access facilities. The following discusses the elements of traffic design that might be different for HOV direct access facilities.

(1) Traffic Barriers

Separate the main line from the HOV direct access facilities with a traffic barrier. Whenever possible, separate opposing traffic lanes in the facility by using traffic barrier. (See Chapter 710.) This is especially important in areas where opposing traffic is changing speeds to or from main line speeds. Concrete barrier is generally preferable on these facilities due to lower maintenance requirements.

The approach ends of traffic barriers must have crashworthy end treatments. In areas where the operating speed is greater than 35 mph, an impact attenuator is required. (See Chapter 720.) Consider concrete barrier and low maintenance impact attenuators, such as the REACT 350 or QuadGuard Elite, where there is a potential for frequent impacts, such as in gore areas.

When the operating speed is 25 mph or less, and where an at-grade pedestrian crossing transit stop has an opening in a concrete barrier, a sloped-down end as shown in the Standard Plans is acceptable.

When a break in the barrier is required for turning maneuvers, consider the sight distance requirements when determining the location for stopping the barrier. (See Chapter 650.)

In areas where headlight glare is a concern, consider glare screens, such as taller concrete barrier. Other glare screen options that mount on the top of a barrier tend to be high maintenance items and are discouraged.

Taller barrier might also be desirable in areas where pedestrian access is discouraged such as between opposing flyer stops and between a flyer stop and the main line.

(2) Signing

It is essential that the design and placement of HOV signing clearly indicate whether the signs are intended for motorists in the HOV lane or the general-purpose lanes. The purposes of the signs include:

- To enhance safety.
- To convey the message that HOV lanes are restricted to HOVs.
- To provide clear directions for entrances and exits.
- To define vehicle occupancy requirements or other restrictions.

Because HOV facilities are not found in many regions, the signing not only considers the commuter but also the occasional user of the facility who might be unfamiliar with the HOV facility and its operation.

(a) **Safety**

Much of HOV signing relates to enhancing safety for the motorists. Not only are geometrics often minimized due to the lack of right of way, but there are unusual operational characteristics such as the differential speed between the HOV vehicle and the adjacent general purpose traffic. The lack of passing opportunities in the HOV lane and the necessity for frequent merging and weaving actions require designers to use messages that are clear and concise, and use symbols wherever possible.

Because left-side off-connections are unusual, advance warning signing that an exit is on the left becomes more important.

For T ramps, provide traffic control at the T to assign priority to one of the conflicting left-turn movements and to avert wrong way movements.

(b) **Diamond Symbols**

The diamond symbol is used to designate all HOV facilities where carpools are allowed. For all signs, whether regulatory, guide, or warning, the symbol is always white on a black background to convey the restrictive nature of the HOV lane and to make the signs more uniformly recognizable. The use of the symbol with all HOV signs also informs drivers that the message is intended for HOVs. The diamond symbol is only for HOV lanes where carpools are allowed, not used for bus, taxi, or bicycle preferential lanes.

(c) **Selection and Location**

The signing details, Figures 1055-16 through 17b, provide for the HOV geometric configurations used within the right of way. Signing for other types of HOV facilities (such as those used for reversible-flow, and HOV direct access between freeways and temporary HOV lanes used during construction) is designed on a case-by-case basis requiring consultation with the appropriate Headquarters and region traffic personnel. The design of signing for HOV direct access between freeways will include HOV guide signs, both advance and action, in addition to the normal regulatory signs.

(d) **Regulatory Signs**

Regulatory signs for HOV facilities follow the normal regulatory signing principles; black legend with a white reflective background on a rectangular panel. Keep in mind that messages conveyed by the HOV signs (such as signs concerning violations and those indicating the beginning of an HOV lane downstream) are not necessarily intended only for the HOV vehicle. Therefore, it might be prudent to place additional signs on the right side of the freeway where this conforms to sound engineering practice.

(e) **Guide Signs**

Guide signs for the HOV facilities are generally used at intermediate on and off locations to inform HOV motorists of upcoming freeway exits and the appropriate location to exit the HOV lane. For HOV direct access to and from arterials, guide signs are used in a fashion similar to normal arterial interchange signing practice. The guide signs for HOV facilities have a black nonreflective legend on a white reflective background. The exception is the diamond, where the white reflective symbol is on a black nonreflective background. For all HOV related guide signs, the diamond is placed in the upper left-hand corner of the sign.

(3) Lighting

Illumination of HOV direct access facilities is required for ramps, loading platforms at transit stops, major parking lots, and walkways as defined in Chapter 840.

(4) Intelligent Transportation Systems

Intelligent transportation systems (ITS) are used to collect traffic data, maintain freeway flow, and disseminate traveler information. Transit information systems for passengers and transit facility surveillance are not normally a part of WSDOT's ITS system, but implementation of these components may be considered for some locations.

Design of HOV direct access facilities, like all HOV facilities, should fully utilize available ITS elements. Need for ITS elements vary depending on project features, such as facility design and operation, and whether the site has existing ITS components.

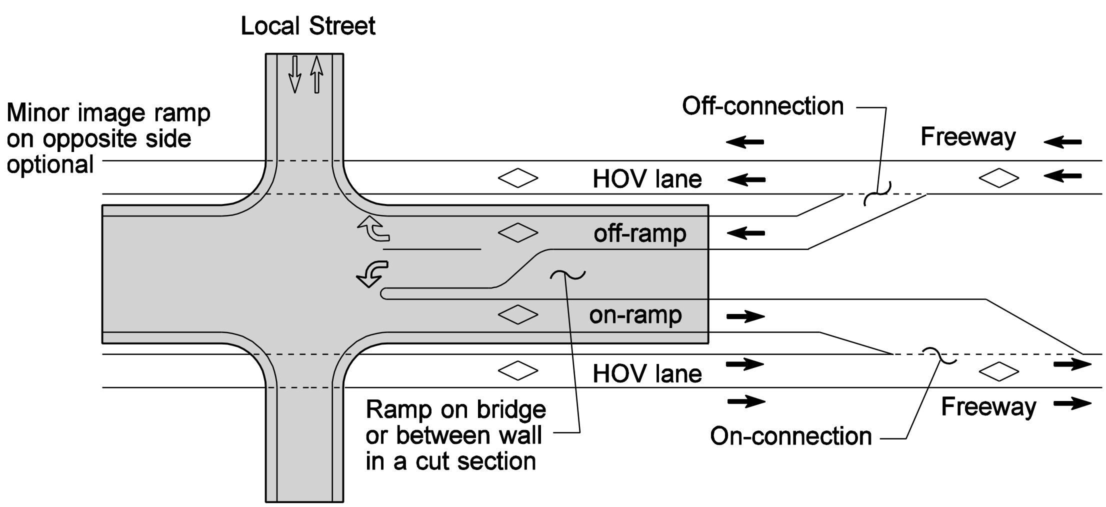
ITS elements that might be applicable to HOV direct access facilities include: closed circuit television surveillance, ramp metering, data collection, exit queue detection and override, dynamic signing, transit signal priority, and automatic vehicle identification and location.

Guidance on the development of ITS elements is found in Chapter 860. Include the region's Traffic Office, transit operator, and affected local agency in the coordination for design and implementation of ITS elements.

1055.08 Documentation

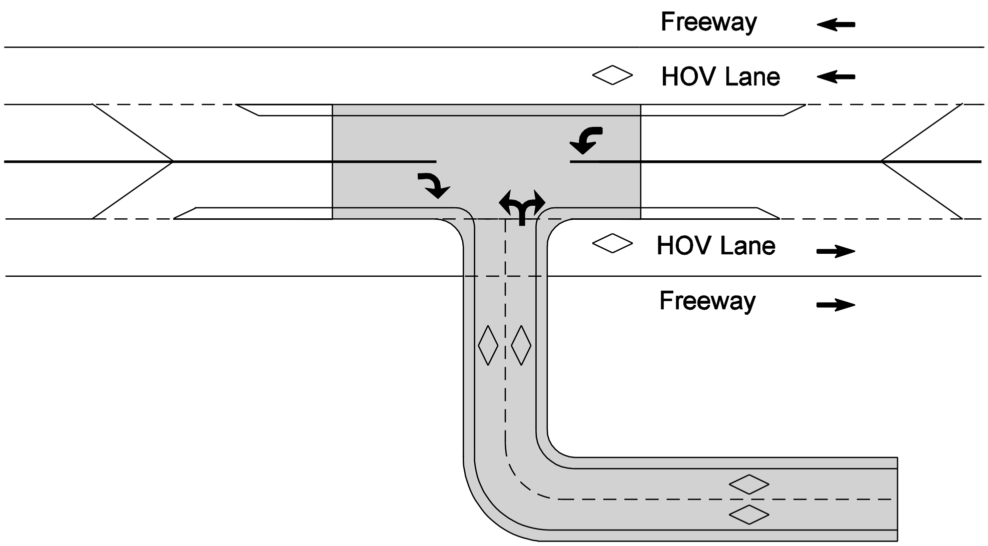
A list of the documents that are to be preserved [in the Design Documentation Package (DDP) or the Project File (PF)] is on the following web site: http://www.wsdot.wa.gov/eesc/design/projectdev/

Photograph from *FHWA/PB HOV Interactive 1.0 High Occupancy Vehicle Data Base from the U.S., Canada and Europe*



Drop Ramp

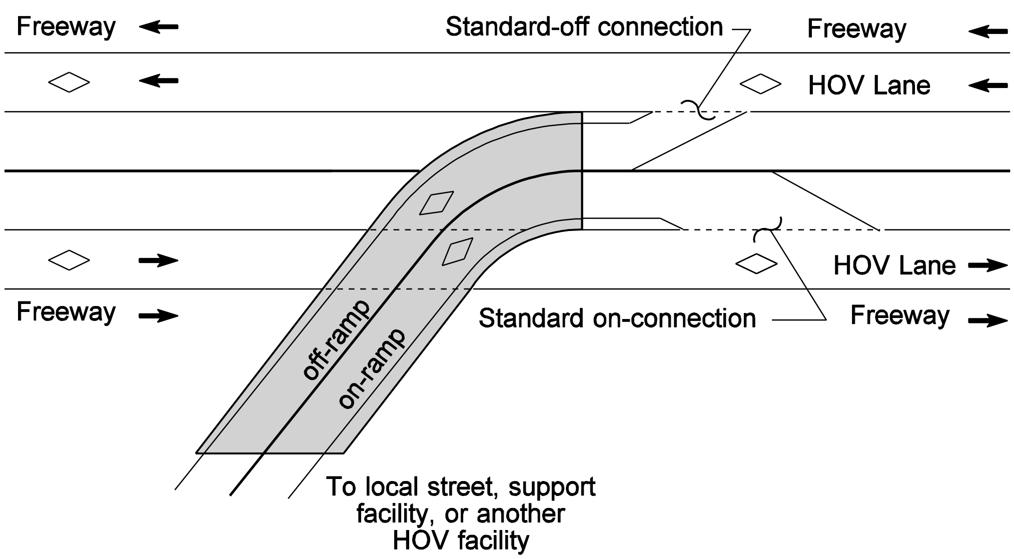
Figure 1055-3



See Figure 1055-15 for additional design information.

T Ramp
Figure 1055-4

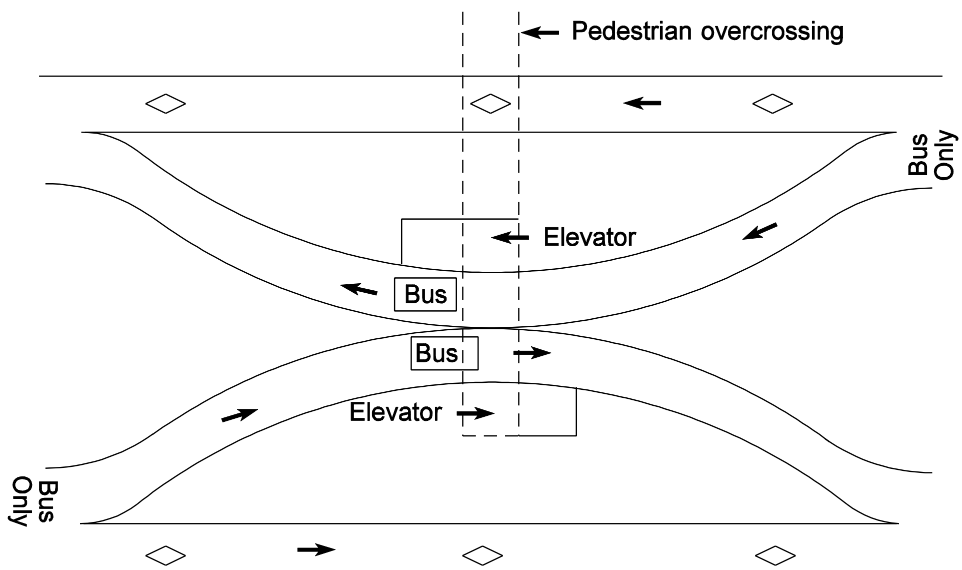
Photograph from *FHWA/PB HOV Interactive 1.0 High Occupancy Vehicle Data Base from the U.S., Canada and Europe*



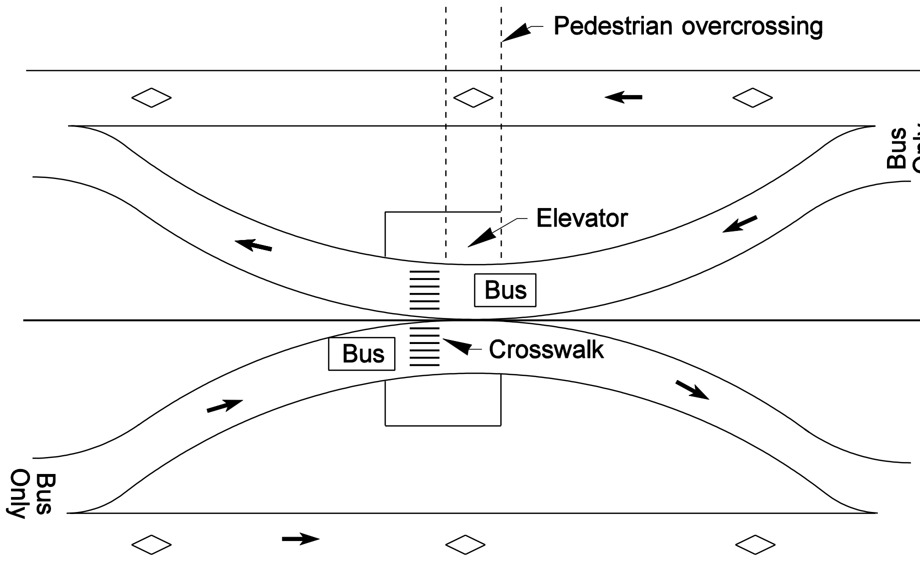
Flyover Ramp
Figure 1055-5

Photograph from *FHWA/PB HOV Interactive 1.0 High Occupancy Vehicle Data Base from the U.S., Canada and Europe*

The side platform flyer stop with grade separated access to each platform is the preferred design.



Side Platform Flyer Stop
Figure 1055-6

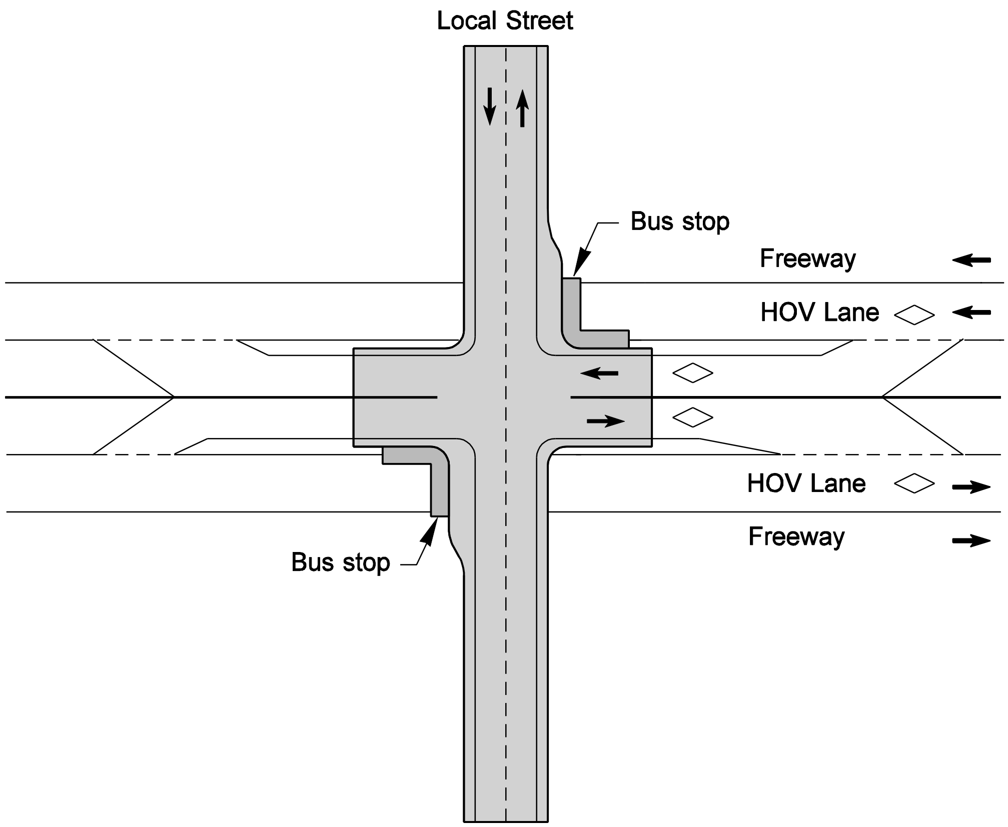


Consider flyer stops with at-grade pedestrian crossing only when anticipated volumes are low. The design must allow for the future addition of grade separated access to both platforms. See side platform flyer stop design, Figure 1055-6.

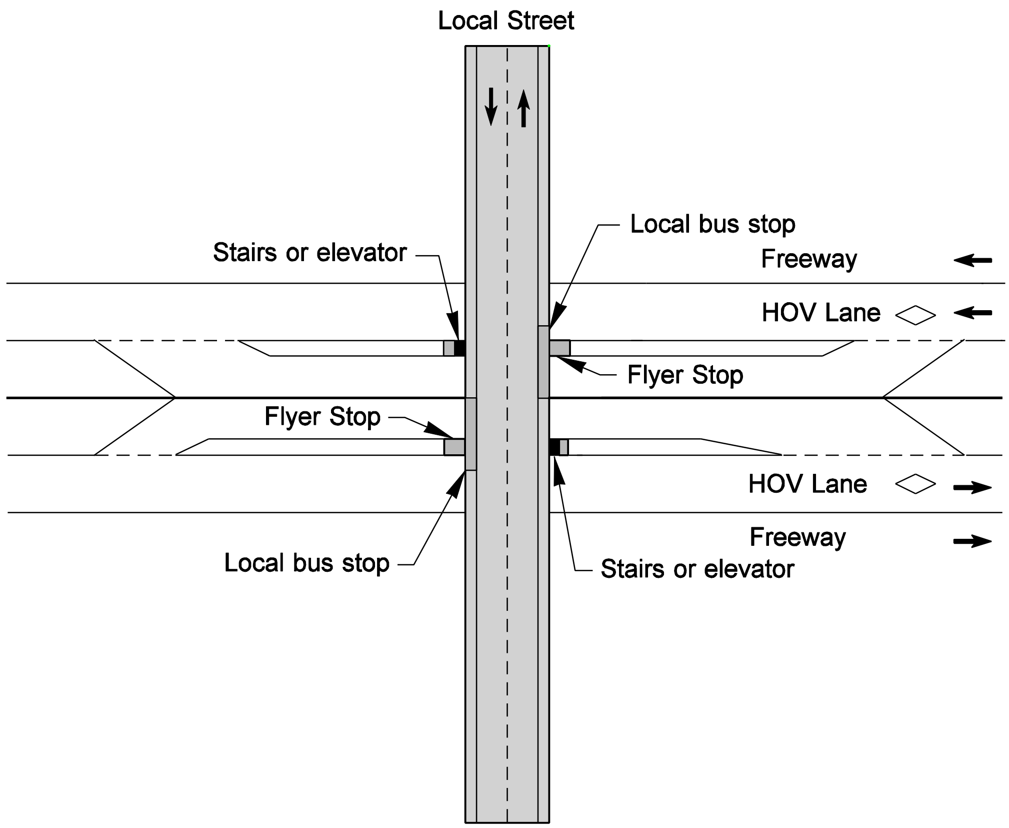
Photograph from *FHWA/PB HOV Interactive 1.0 High Occupancy Vehicle Data Base from the U.S., Canada and Europe*

At-Grade Crossing Flyer Stop

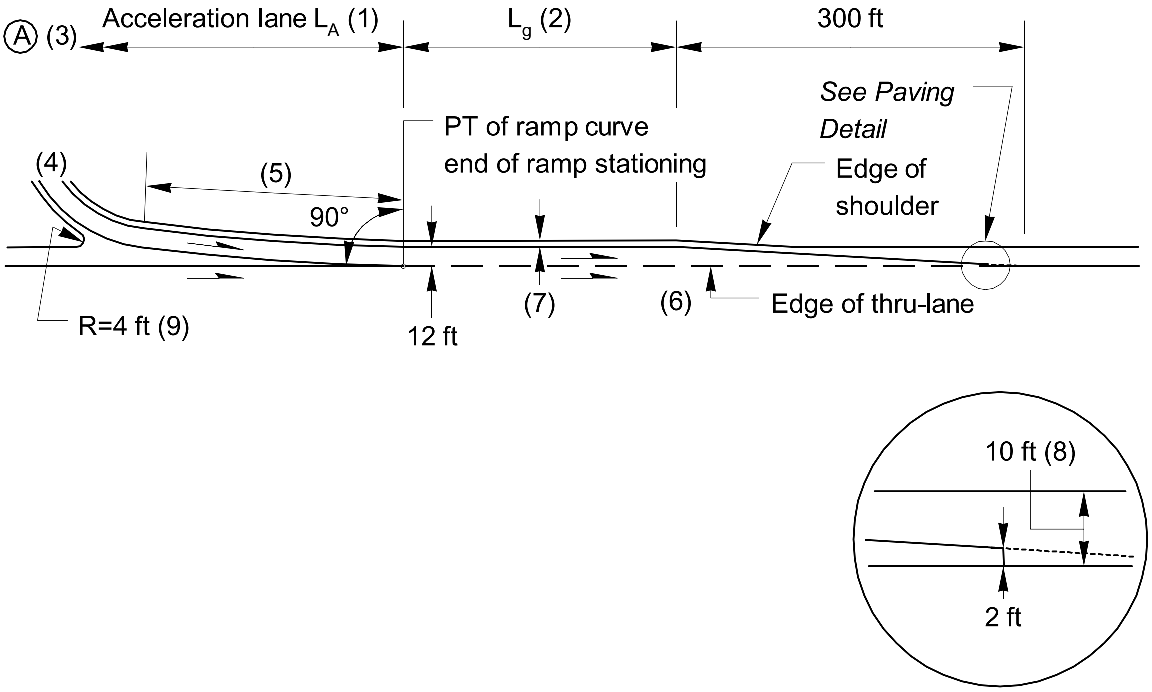
Figure 1055-7



Transit Stops at Ramps
Figure 1055-8



Other Transit Stops
Figure 1055-9



Paving Detail

Notes:

(1) See Figure 1055-11 for acceleration lane length L_A.
Check L_A for each ramp design speed.

(2) L_g is the gap acceptance length. Begin L_g at the beginning of the parallel lane, as shown, but not before the end of the acceleration lane L_A. See Figure 1055-2 for the length L_g.

(3) Point (A) is the point controlling the ramp design speed or the end of the transit stop zone or other stopping point.

(4) See 1055.05(5) for ramp lane and shoulder widths.

(5) A transition curve with a minimum radius of 3,000 ft is desirable. The desirable length is 300 ft. When the main line is on a curve to the right, the transition may vary from a 3,000 ft radius to tangent to the main line. The transition curve may be replaced by a 50:1 taper with a minimum length of 300 ft.

(6) Angle point for width transitions, when required. See Chapter 620 for pavement transitions.

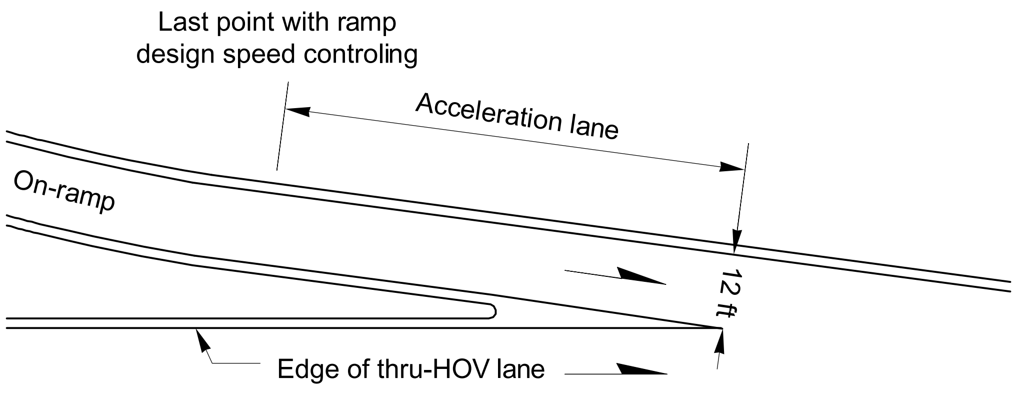
(7) See 1055.05(5)(b) for ramp shoulder width.

(8) The 10 ft left shoulder is the minimum width; 14 ft is preferred. Maintain this shoulder width for at least 500 ft; 1,000 ft is preferred.

(9) Radius may be reduced when concrete barrier is placed between the ramp and main line.

(10) For striping, see the Standard Plans.

Single Lane Parallel On-Connection
Figure 1055-10



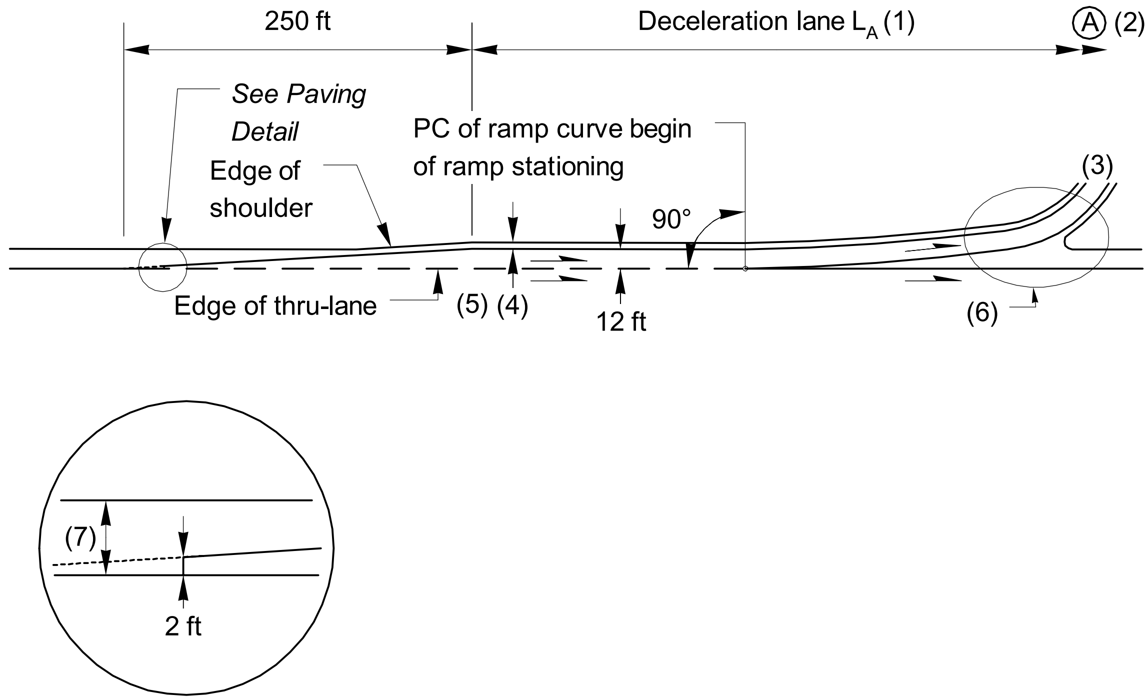
Freeway Speed (mph)	Ramp Design Speed								
	0	15	20	25	30	35	40	45	50
40	555	480	420	340	185				
45	835	760	700	615	470	290			
50	1230	1160	1100	1020	865	685	310		
55	1785	1715	1655	1575	1420	1235	875	410	
60	2135	2085	2040	1985	1875	1735	1440	995	460
70	3045	3015	2985	2945	2860	2745	2465	2050	1515
80	4505	4465	4420	4370	4250	4095	3745	3315	2780

Acceleration Length (L_A) for Buses (ft)

For the adjustment factors for grade, see Acceleration lane length in Chapter 940.

HOV Direct Access Acceleration Lane Length

Figure 1055-11



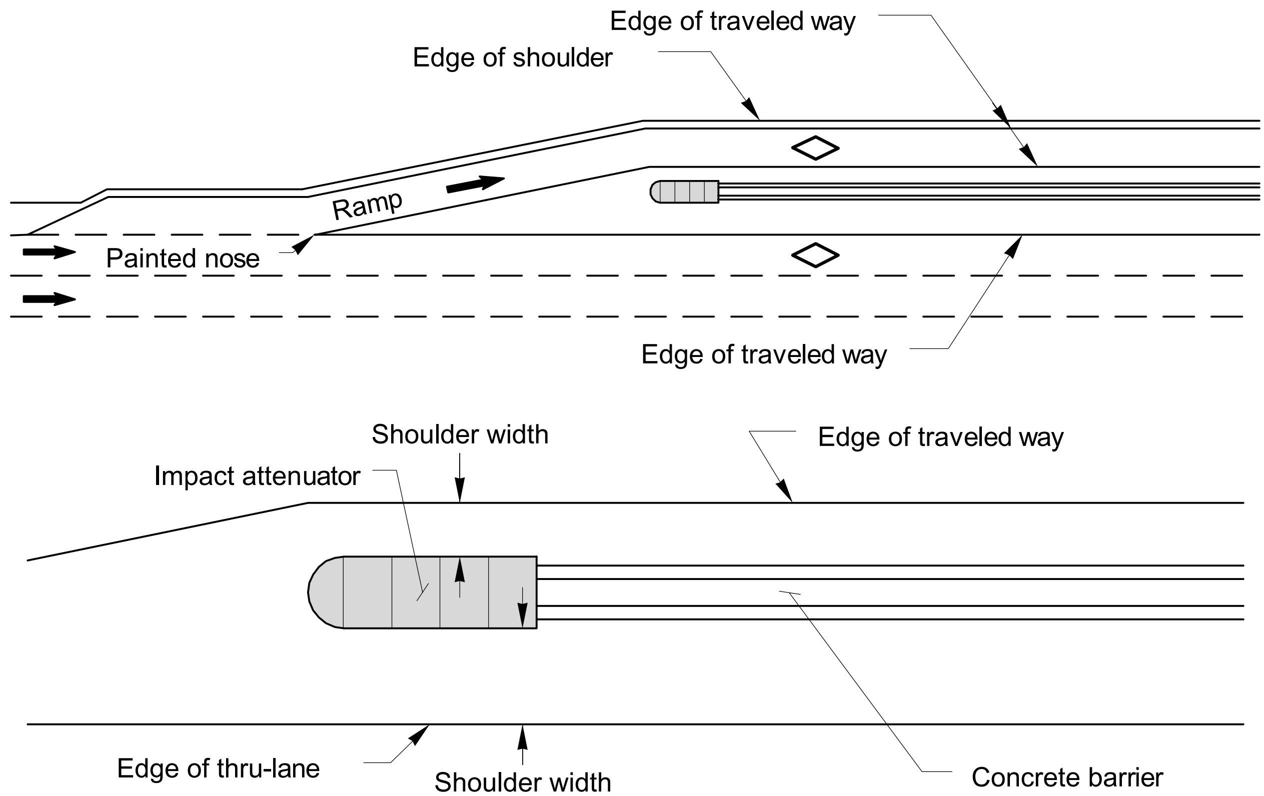
Paving Detail

Notes:

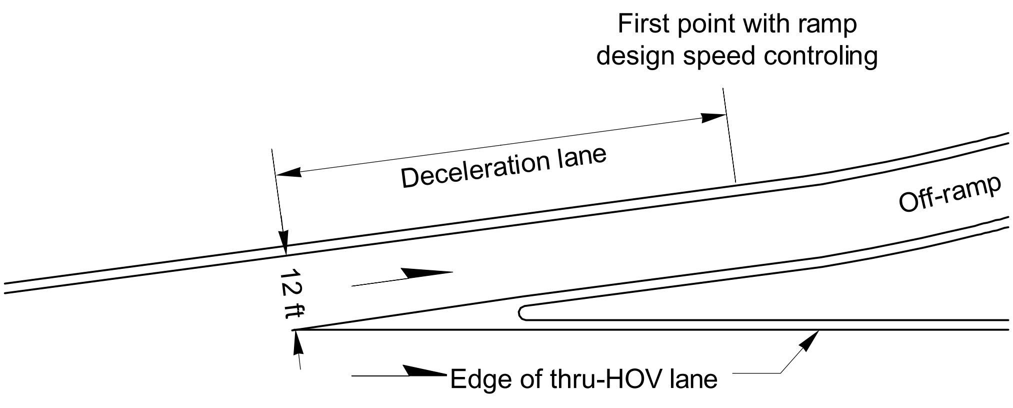
(1) See Figure 1055-14 for deceleration lane length L_D.
Check L_D for each ramp design speed.
(2) Point A is the point controlling the ramp design speed or the end of the transit stop zone or other stopping point.
(3) See 1055.05(5) for ramp lane and shoulder widths.
(4) See 1055.05(5)(b) for ramp shoulder width.
(5) Angle point for width transitions, when required. See Chapter 620 for pavement transitions.
(6) Gore area details at drop ramp connections (Figure 1055-3) are shown on Figure 1055-13. See Chapter 940 for gore details at other connection types.
(7) The desirable shoulder width is 10 ft.
(8) For striping, see the Standard Plans.

Single Lane Parallel Off-Connection

Figure 1055-12



Drop Ramp Gore Area Characteristics
Figure 1055-13

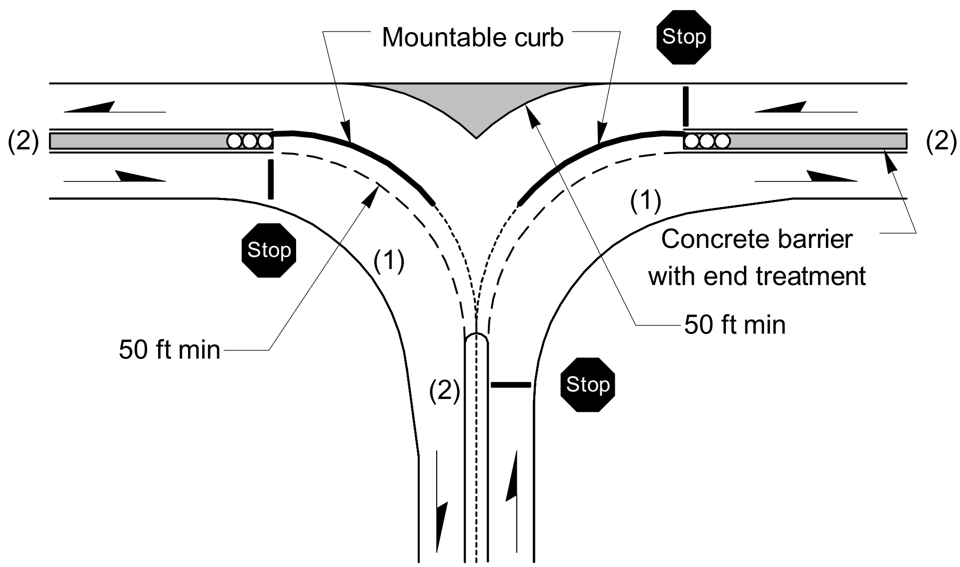


Highway Speed (mph)	Ramp Design Speed (mph)								
	0	15	20	25	30	35	40	45	50
40	390	330	290	240	170	100			
45	470	420	380	330	260	190	90		
50	570	520	480	430	360	290	190	100	
55	680	620	590	540	470	400	300	210	110
60	800	740	700	660	580	520	420	330	230
70	990	930	900	850	780	710	610	520	420
80	1210	1150	1110	1060	990	920	830	740	640

Deceleration Length (LD) for Buses (ft)

For the adjustment factors for grade, see deceleration lane length in Chapter 940.

Deceleration Lane Length for Buses
Figure 1055-14



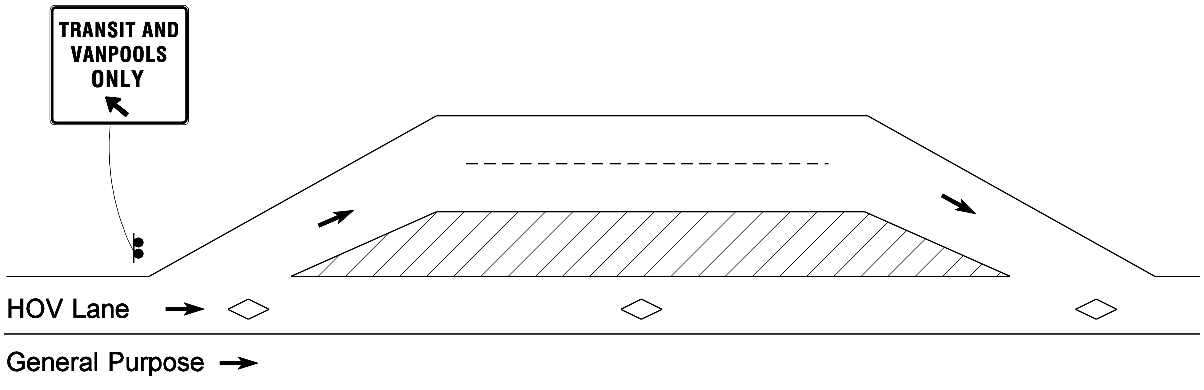
Notes:

(1) See Chapter 910 for intersection corner design. Use the right-turn corner design for the WB-40 for both the left and right turns.

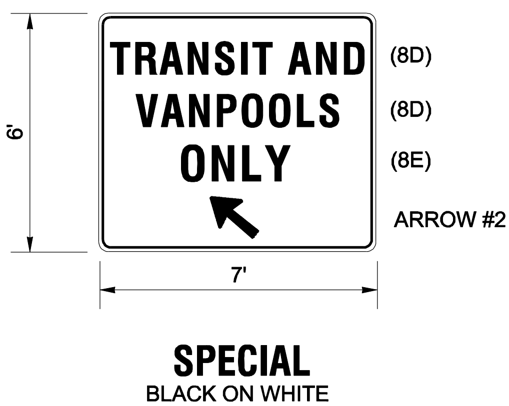
(2) See 1055.05(5) for ramp lane and shoulder widths.

T Ramp Design

Figure 1055-15

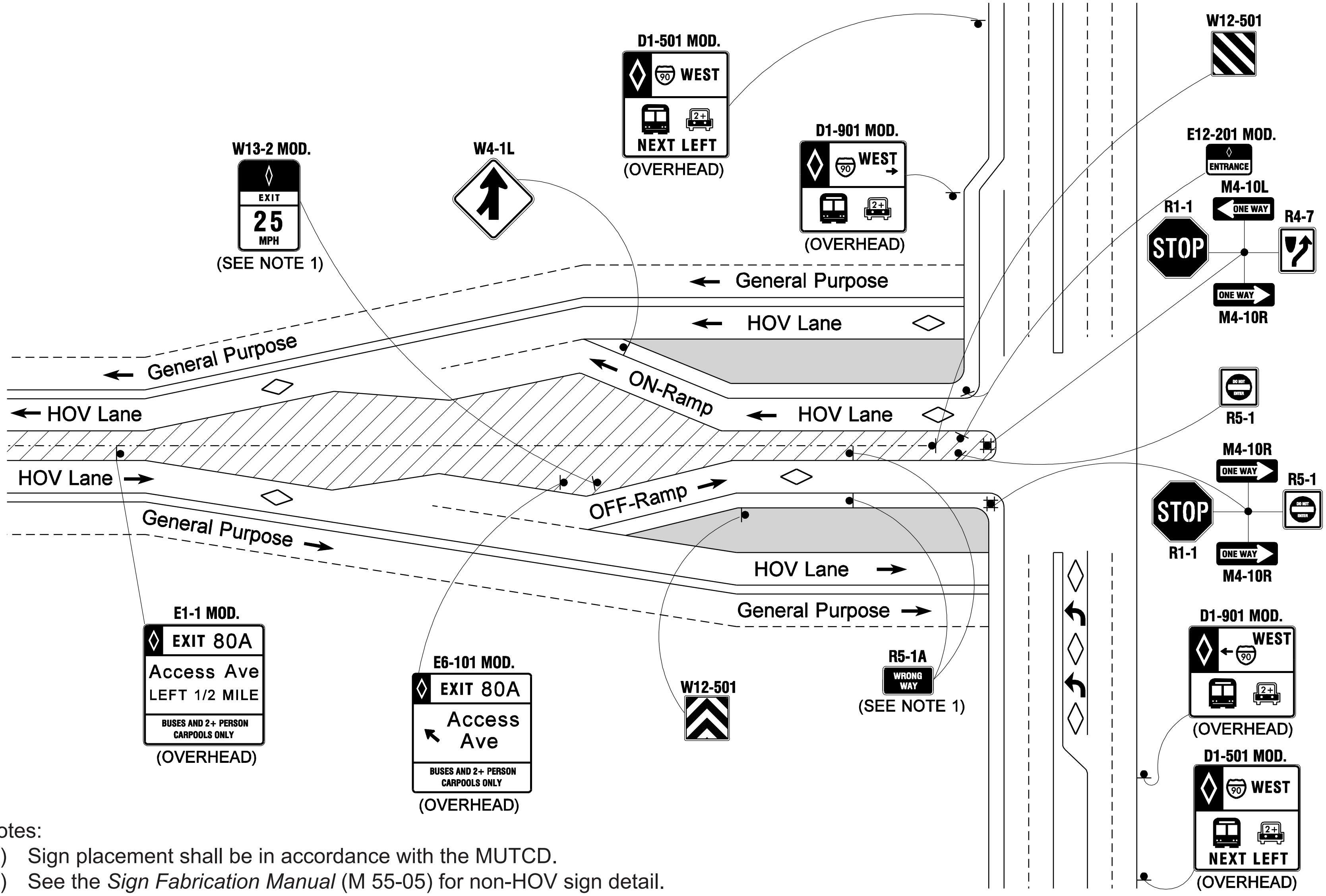


Typical Signing for Flyer Stop



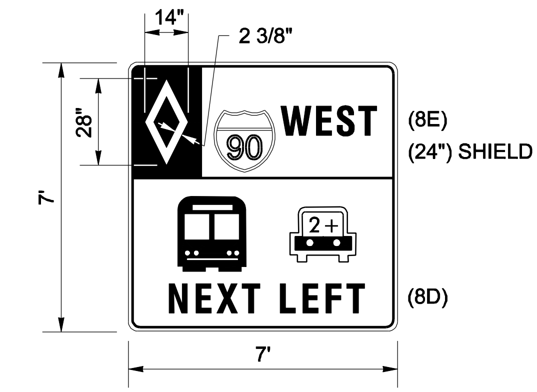
Special Flyer Stop Sign

Flyer Stop Signing
Figure 1055-16

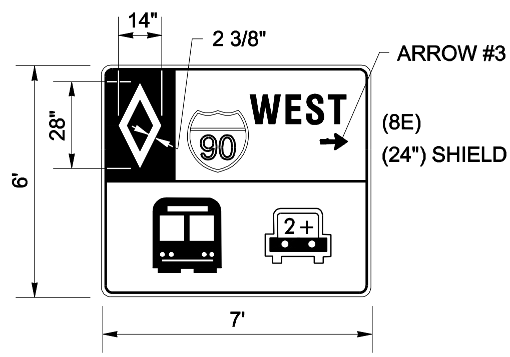


Notes:
(1) Sign placement shall be in accordance with the MUTCD.
(2) See the *Sign Fabrication Manual* (M 55-05) for non-HOV sign detail.
(3) See Figure 1055-17b for modified sign details.

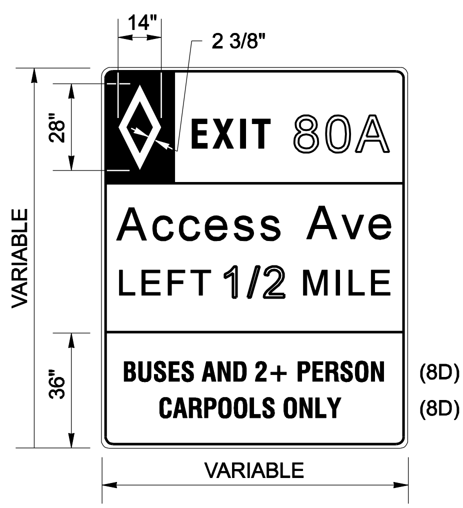
HOV Direct Access Signing
Figure 1055-17a



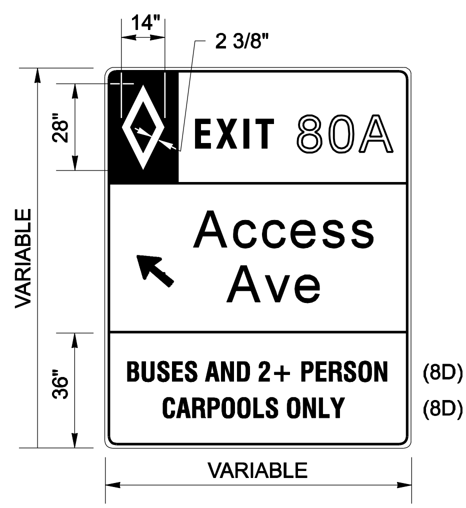
D1-501 MOD.
BLACK ON WHITE



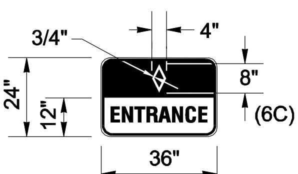
D1-901 MOD.
BLACK ON WHITE



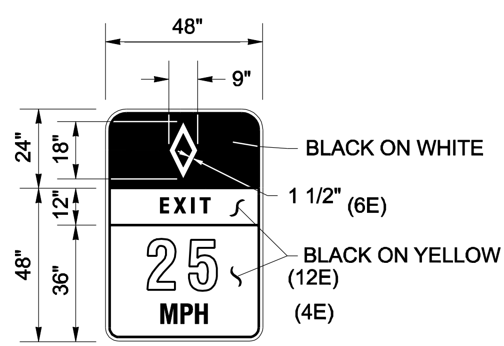
E1-1 MOD.
CODE D
BLACK ON WHITE



E6-101 MOD.
CODE D
BLACK ON WHITE



E12-201 MOD.
BLACK ON WHITE



W13-2 MOD.

HOV Direct Access Signing
Figure 1055-17b